

Technical Information Manual

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MOD. A 1512
12 CH FLOATING
HV BOARD
MANUAL REV.5

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CAEN declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly the CAEN User's Manual before any kind of operation.



CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

Disposal of the Product

The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.



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1. Introduction

1.1 The CAEN Universal Multichannel Power Supply System

The SY 1527 system is the fully equipped, large scale experiment version of a new line of power supply systems which represent CAEN's latest proposal in the matter of High Voltage and Low Voltage Power Supplying. This system outlines a completely new approach to power generation and distribution by allowing to house, in the same mainframe, a wide range of boards with different functions, such as High/Low Voltage boards, generic I/O boards (temperature, pressure monitors, etc.) and branch controllers, where the latter are used to control other remote generators and distributors.

Modularity, flexibility and reliability are the key-points of its design, enabling this module to meet the requirements of a wide range of experimental conditions. The latter range from those of LHC experiments, in which the model's features find prior application, to those of other less challenging, but still demanding, High Energy Physics experiments.

The mainframe is housed in a 19"-wide, 8U-high euro-mechanics rack and hosts four main sections:

- the *Board Section*, with 16 slots to house boards, distributors and branch controllers;
- the *Fan Tray Section*, housing 6 fans disposed on two rows;
- the *Power Supply Section*, which consists of the primary power supply and up to 3 power supply units;
- the *CPU and Front Panel Section* which includes all interface facilities.

The User interface features the usual friendliness of the previous CAEN systems which now also includes a 7.7" colour LCD. A wide choice of interfaces provides full communication compatibility with the previous systems and the possibility of controlling heterogeneous external devices.

Modularity has been one of the leading criteria in the design and development of the system: both the *Power Supply Section* and the *Board Section* are completely modular. The *Power Supply Section* allows different configurations with up to 3 power supply units per mainframe (up to 2250 W), while the *Board Section* can house up to 16 boards able to fulfil different functions. A new line of boards and distributors, analogous with those available for the SY 527 system, and a set of branch controllers has been specially developed for this new system. The minimum system configuration consists of the primary power supply, one Power Supply Unit and one board.

The concept of modularity has been extended up to the possibility of arranging 'clusters' constituted by one 'intelligent' SY 1527 system able to drive other 'non-intelligent' systems, i.e. systems without CPU (to be implemented). The connections among the systems constituting the cluster are realised through a new CAEN interface, the Local Net.

The extreme flexibility of the system, which allows to house indifferently, inside the same mainframe, boards with different functions, is further enhanced by the possibility of developing *ad-hoc* boards and even complete custom peripheral systems. The latter, actually, can be designed specifically for on-detector installation. All the custom

electronics can be anyway remotely controlled by single boards which are inserted in the SY 1527 mainframe and act as branch controllers.

Fast, accurate set-up and monitoring of system parameters (14-bit resolution on Voltages and Currents with standard boards) is available for each branch controller thanks to the use of one microprocessor per slot. All the operational parameters are stored in a non-volatile memory (EEPROM) to be still available after Power-Off. The parameters can be controlled either via CAEN traditional built-in links (RS232, H.S. CAENET) or via CERN-approved Fieldbuses or via Ethernet (TCP/IP). Programmable handling of parameters and errors is available as well.

Channel trip control on other crates is performed via four external differential trip lines. A sophisticated trip handling via software allows to control and correlate trip conditions on the channels of the crate as well as of other crates connected to it.

Live insertion and extraction of the boards, which reduces the global down time, and easy access to the computing core and peripherals completes the system's flexibility.

Easy interfacing is another key-point of the SY 1527 system. Thanks to the H.S. CAENET interface, the system ensures full communication compatibility with the previous models. Besides the RS232 interface and Ethernet (TCP/IP) provided with the standard version of the system, CAN-bus can be furnished on request, as well as special boards featuring optical links for remote communications. The Power Supply Section and Board Section can be externally synchronised via front panel connectors.

Secure access to the system via Intranet is foreseen together with a multilevel management of custom User's profiles. In particular, three different access levels have been implemented: *Guest*, *User* and *Administrator*, each of which with password protection.

Handy maintenance and upgrading, which constitute a major issue in the reliability of a system, are further guaranteed by the possibility of accessing and servicing the system via network facilities. Actually, Telnet and WWW access facilities allow remote debugging and technical support of the system, including future firmware upgrading.

For a detailed description of the SY 1527 Universal Multichannel Power Supply System please refer to the *SY 1527 User's Manual*.

1.2 Technical Specifications Table of the SY 1527 system

Table 1.1 – Technical specifications of the SY 1527 mainframe: general

Packaging	- 19"-wide, 8U-high Euro-mechanics rack; - Depth: 720 mm.
Weight	-Mainframe (*): 24 kg -Mod. A1532: 3.2 kg
Power requirements	<i>Voltage range:</i> 100/230 V <i>Frequency:</i> 50/60 Hz <i>Power:</i> 3400 W
Max. number of boards per crate	16
Max. number of power supply units per crate	3
Primary power supply output (Mod. A 1531)	± 12 V, 8 A +5 V, 20 A
Power supply unit output (Mod. A 1532)	+48 V, 15.6 A
Max. output power	2250 W
Operating temperature	From 0°C (dry atmosphere) to +40°C
Storage temperature	From -20°C (dry atmosphere) to +50°C

(*) One Primary Power Supply (Mod. A 1531) and one Power Supply Unit (Mod. A 1532) are included; boards are not included.

2. Mod. A 1512 High Voltage Board

2.1 Functional description

The Model A 1512 single width board houses 12 HV floating channels (i.e. the channels do not share any ground reference). The output voltage can be programmed and monitored in the range 0÷500 V with 100 mV resolution. The floating channels allow on-detector grounding, thus avoiding ground-loops which may increase noise level.

The Mod. A 1512 offers dual 100 μ A / 1 mA current Full Scale Range (selectable via internal jumpers).

If the output voltage differs from the programmed value by more than 3% of voltage full scale range, the channel is signalled to be either in OVERVOLTAGE or UNDERVOLTAGE condition. Moreover, for each channel, a voltage protection limit SVMAX can be fixed via software with 1 V resolution and the output voltage can not be programmed beyond this value.

The HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷ 50 V/s in 1 V/s steps.

The output current is monitored with 10 nA / 100 nA resolution depending on current range; if a channel tries to draw a current larger than its programmed limit it is signalled to be in OVERCURRENT condition; the SY 1527 system detects this state as a fault and reacts according to the setting of the TRIP parameter¹, namely:

1) TRIP=infinite (= 1000 s)

When the set output current value is reached the channel behaves like a constant current generator.

2) TRIP=finite (< 1000 s)

The output current keeps the set value only for programmed time interval and then is switched off.

The TRIP time (i.e. the maximum time an OVERCURRENT condition is allowed to last) can be programmed in 0.1 s steps.

The maximum output voltage (VMAX Hardware) can be fixed, through a potentiometer located on the front panel, at the same common value for all the board channels and this value can be read out via software.

The board hosts also a temperature sensor located on the PCB near the HV channels: the temperature values measured by this sensor are used to signal Over Temperature condition on the SY 1527.

The board is provided with an "HV EN" input that disables the channels when it is not connected to ground.

¹ Refer to the SY1527/SY2527/SY3527 User's Manuals for details about the TRIP Handling

2.2 Channel Characteristic Table

Table 2.1 – Channel characteristics of the Mod. A 1512 dual range HV Board

Output Voltage:	0÷500 V
Max. Output Current:	low range 100 μ A high range 1mA
Voltage Set/Monitor Resolution:	100 mV
Current Set/Monitor Resolution:	10 nA /100 nA depending on current range
VMAX hardware:	0÷500 V common for all the board channels
VMAX hardware accuracy:	$\pm 2\%$ of FSR
VMAX software:	0÷500 V settable for each channel
VMAX software resolution:	1V
Ramp Down:	1÷50 Volt/sec, 1 Volt/sec step
Ramp Up:	1÷50 Volt/sec, 1 Volt/sec step
Voltage Ripple: ²	< 30 mV pp
Voltage Monitor vs. Output Voltage Accuracy: ³	typical: $\pm 0.3\% \pm 0.5$ V maximum: $\pm 0.3\% \pm 1$ V
Voltage Set vs. Output Voltage Accuracy: ²	typical: $\pm 0.3\% \pm 0.2$ V maximum: $\pm 0.3\% \pm 0.5$ V
Current Monitor vs. Output Current Accuracy: ²	1 mA range typical: $\pm 2\% \pm 0.5$ μ A 1 mA range maximum: $\pm 2\% \pm 1$ μ A 100 μ A range typical: $\pm 2\% \pm 0.05$ μ A 100 μ A range maximum: $\pm 2\% \pm 0.1$ μ A
Current Set vs. Output Current Accuracy: ²	1 mA range typical: $\pm 2\% \pm 0.5$ μ A 1 mA range maximum: $\pm 2\% \pm 1$ μ A 100 μ A range typical: $\pm 2\% \pm 0.05$ μ A 100 μ A range maximum: $\pm 2\% \pm 0.1$ μ A

² From 10 Hz to 20 MHz at full load

³ From 10% to 90% of Full Scale Range

2.3 Front Panel

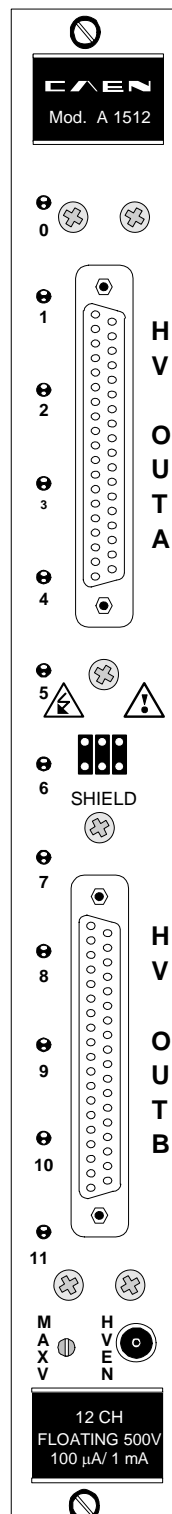


Fig. 2.1 – Mod. A1512 front panel

2.4 Technical Specifications

2.4.1 Packaging

The module is housed in a 1 units wide, 6U-high mechanics.

2.4.2 External connections

The location of all components of the front panel is shown in Fig. 2.1. The function and electro-mechanical specifications of the external connectors are listed in the following subsections.

CH 0...5 HV CONNECTORS:

Mechanical specifications:

DB 37 type female connector

Electrical specifications:

HV 37pin connector

CH 6...11 HV CONNECTORS:

Mechanical specifications:

DB 37 type female connector

Electrical specifications:

HV 37pin connector

HV EN CONNECTOR

Mechanical specifications:

00-type LEMO connector

Electrical specifications:

board ENABLE input, if it is connected to ground, the channels are enabled

2.4.3 Displays

CH ON 0...11 LEDs:

Function: they light up as the relevant channel is on

Type: red LEDs

2.4.4 Front Panel Jumpers

JP1, JP2, JP3 :

Type: two pin jumpers

Function: grounding of the front panel connectors' shield (see also § 4.3.2)

2.4.5 *Other components*

MAXV trimmer:

Function: it allows to adjust the hardware maximum voltage VMAX common to all the channels. Its value can be read out via software

3. Safety information and installation requirements

3.1 General safety information

This section contains the fundamental safety rules for the installation and operation of the board. Read thoroughly this section before starting any procedure of installation or operation of the product.

3.1.1 *Injury Precautions*

Review the following precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.

Avoid Electric Overload.

To avoid electric shock or fire hazard, do not apply a voltage to a load that is outside the range specified for that load.

Avoid Electric Shock.

To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

Do Not Operate Without Covers.

To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet/Damp Conditions.

To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere.

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Do Not Operate With Suspected Failures.

If you suspect there is damage to this product, have it inspected by qualified service personnel.

3.2 Safety Terms and Symbols on the Product

These terms may appear on the product:

- **DANGER** indicates an injury hazard immediately accessible as you read the marking.
- **WARNING** indicates an injury hazard not immediately accessible as you read the marking.
- **CAUTION** indicates a hazard to property including the product.

The following symbols may appear on the product:



DANGER
High Voltage



ATTENTION
Refer to Manual

3.3 Installation

The Mod. A 1512 is a single-width board. At power ON the SY 1527 system processor will scan all the slots in the crate to find out where the module is plugged and what kind of module it is.

N.B.: the board does not allow “live extraction”; the board must be disabled (see § 4.4.1) before it is removed from the system.

4. Operating modes

The Mod. A 1512 board can be controlled, either locally or remotely, through the SY 1527 software interface. For details on SY 1527 system operation, please refer to the User's Manual of this product. The following sections contain a description of commands available for the board control and status monitoring.



ATTENTION

**THE MOD. A 1512 BOARD REQUIRES
SY 1527 FIRMWARE VERSION 1.09.04 OR LATER**

4.1 Output control and monitoring

For each output channel, it is possible, through the SY 1527 system, to perform the following operations:

- Assign to channel a symbolic name
- Set output voltage (VSET)
- Set max. output current (ISET)
- Set output voltage software limit (SVMAX)
- Set voltage ramp-up speed (RAMP-UP)
- Set voltage ramp-down speed (RAMP-DOWN)
- Set TRIP parameter
- Enable/disable POWER ON option
- Switch channel ON/OFF
- Monitor output voltage (VMON)
- Monitor output current (IMON)
- Monitor channel status

If the POWER ON option is enabled, the channel, at POWER ON, is restored in the same condition it was before the POWER OFF or RESET; if this option is disabled, at POWER ON or after a RESET, the channel is kept OFF independently from its previous condition.

The following messages may be returned by the SY 1527 when monitoring the channel status:

- OFF (channel turned OFF)
- RUP (channel ramping up)
- RDWN (channel ramping down)
- OVC (channel in OVERCURRENT condition)
- OVV (channel in OVERVOLTAGE condition)

- UNV (channel in UNDERVOLTAGE condition)
- EXTTRIP (channel OFF due to external TRIP line signal)
- INTTRIP (channel OFF due to internal OVERCURRENT condition)
- EXT_DIS (channel disabled by board INTERLOCK protection)

Moreover it is possible to monitor board temperature and to check board status; the following messages may be returned by the SY 1527 when monitoring the board status:

- UNDER_TEMP (board temperature < 5°C)
- OVER_TEMP (board temperature > 65°C)

4.2 Current range setting

The Mod. A 1512 current Full Scale Range, can be selected between 100 μ A and 1 mA for each channel via internal jumpers (two per channel).

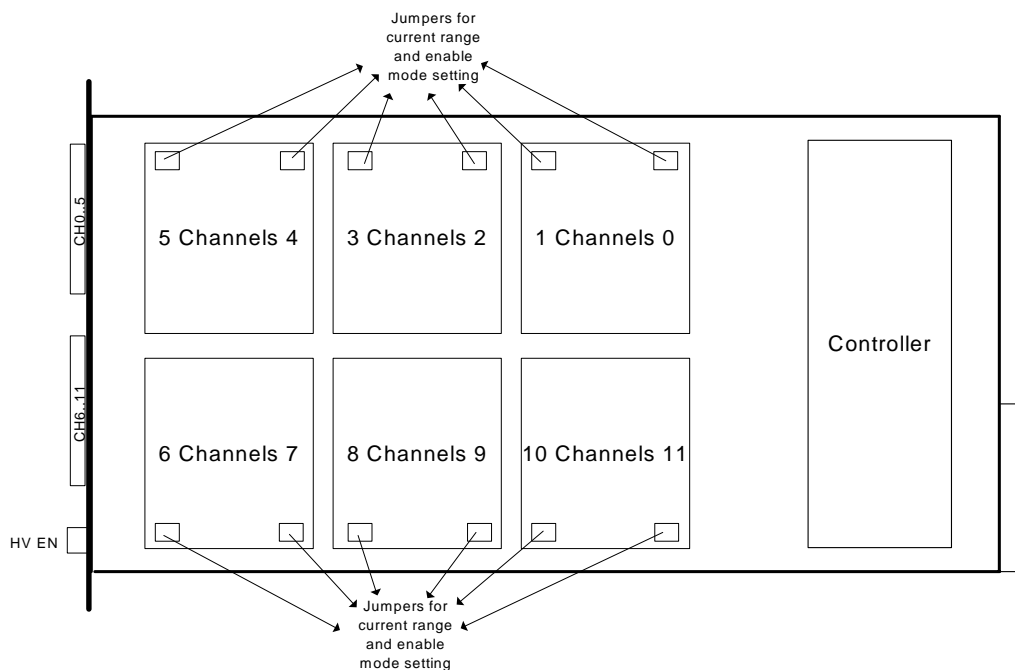


Fig. 4.1 – Mod. A 1512 side view

In order to select the desired current Full Scale Range (independent for each channels), the jumpers must be set as shown in Fig. 4.2 (i.e. the pins must be short circuited as shown); the channels are organised into 6 blocks of 2 channels (see Fig. 4.1). Current range selection must be performed before inserting the board into the crate. Default factory setting is 1 mA Full Scale Range.

TWO CHANNEL BLOCK (one of six)

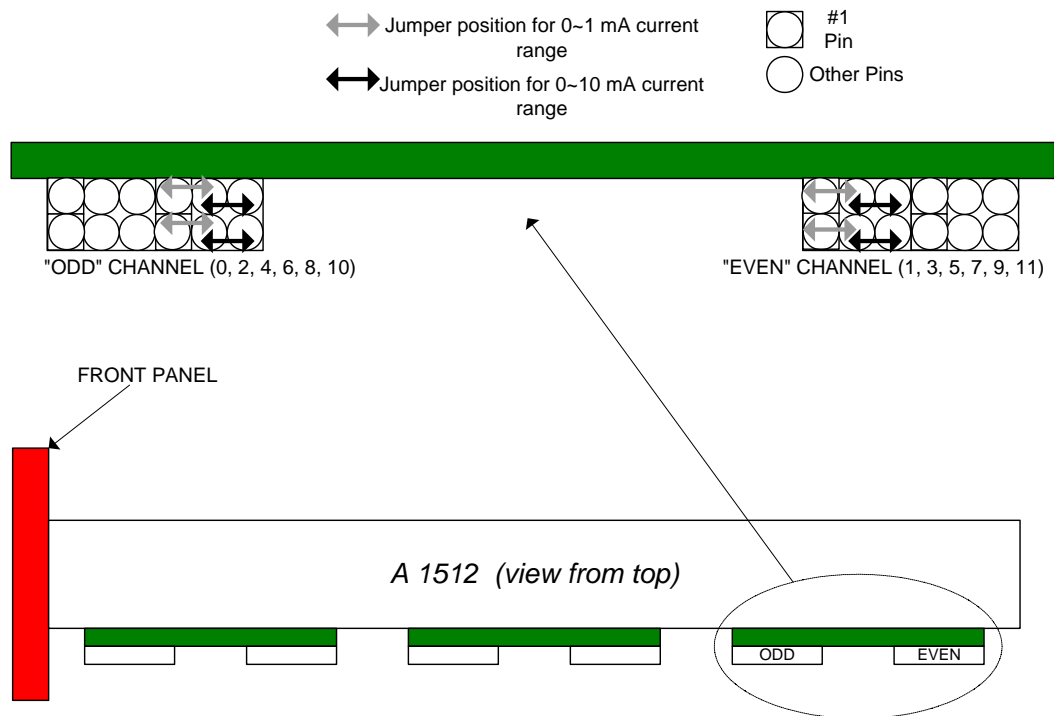


Fig. 4.2 – Current range jumper setting

4.3 Pin assignment

The following figure shows the pin assignment of the front panel connectors:

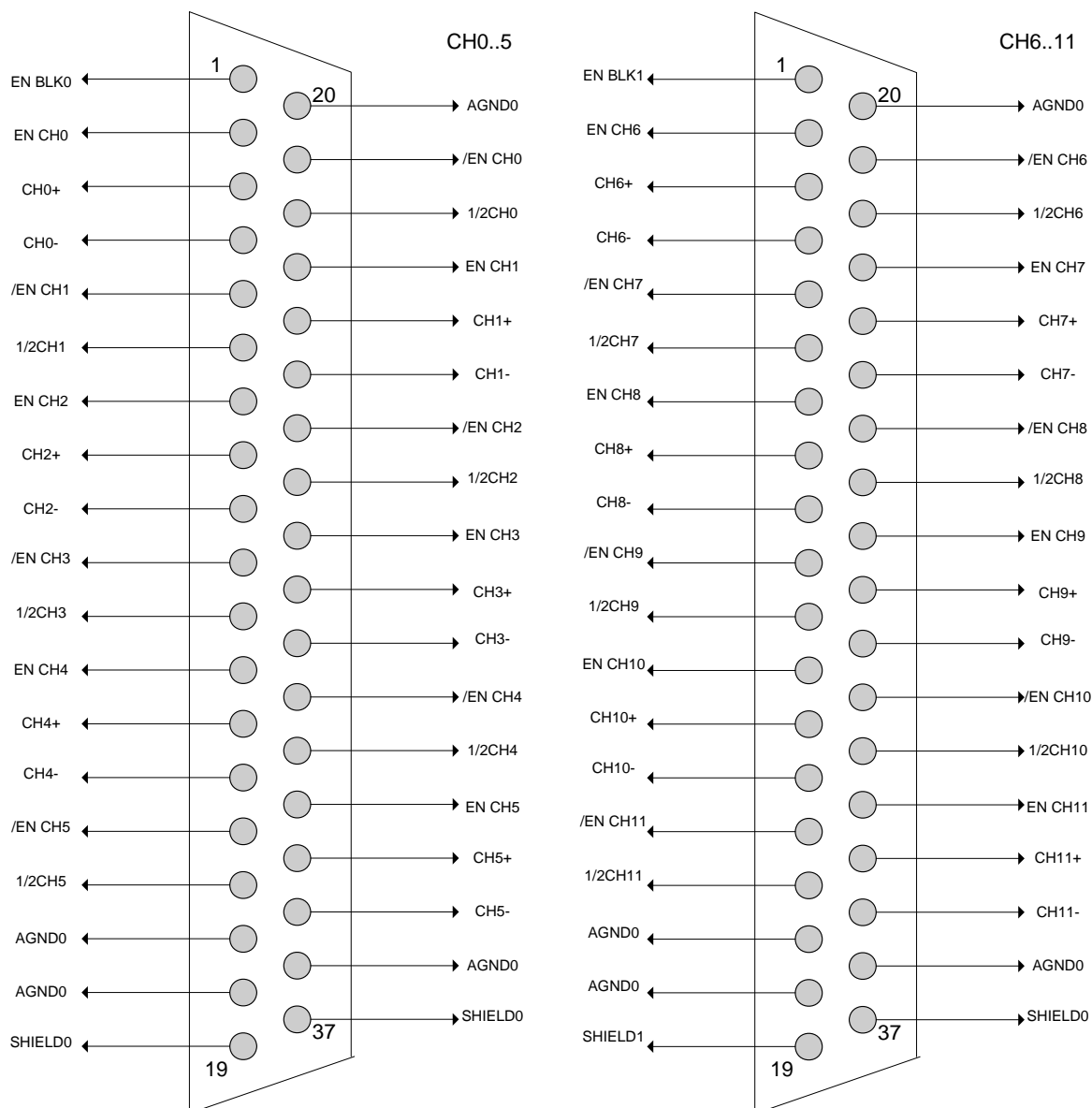


Fig. 4.3 – Mod. A 1512 front panel connectors pin assignment

4.3.1 Front panel connectors pin assignment description

- $CHx+$ and $CHx-$: they are the x channel's HV outputs (x ranging from 0 to 11)
- $\frac{1}{2} CHx$: it is a reference voltage (high impedance, thus not available as a power source) whose value is $\frac{1}{2} \cdot |CHx+|$
- $ENCHx$ and $/ENCHx$: ENMODE0: short circuiting these pins, x channel is disabled; ENMODE1: x channel is enabled when a +5 V d.c. voltage difference is applied between $ENCHx$ and $/ENCHx$ pins (see § 4.4.2)
- $ENBLK0/1$: grounding these pins channels 0÷5 ($ENBLK0$) and 6÷11 ($ENBLK1$) are enabled
- $AGND0$: these pins are connected to the crate ground
- $SHIELD0/1$: these pins are connected to the connector's external shield

4.3.2 Front panel jumpers

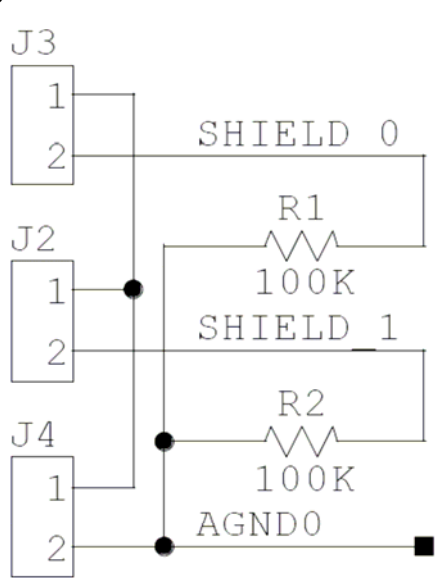


Fig. 4.4 – Front panel jumpers

The front panel jumpers J2, J3 and J4 allow to connect the two DB37 connectors shields (SHIELD0 and SHIELD1) with the ground reference of the crate (AGND0).

4.4 Output Enable

It is possible to enable the board's channels in the following ways.

4.4.1 Board Enable

The board is provided with an "HV EN" input that enables the channels when it is terminated on 50 Ohm. When the channels are disabled (the 50 Ohm termination is removed), the voltage outputs drop to zero at the maximum rate available; when the output disable cause is removed, i.e. the "HV EN" connector is terminated on 50 Ohm, the channels remain OFF until the User turns them ON via software.

4.4.2 Channel Enable

Each channel can be either enabled or disabled singularly. This operation can be performed in two ways, according to the mode, selected via jumpers (see Fig. 4.5):

- *ENMODE0*: if ENCHx and /ENCHx front connector pins (see Fig. 4.3) are not connected, x channel is enabled; if ENCHx and /ENCHx pins are short circuited, channel x is disabled
- *ENMODE1*: a +5 V d.c. voltage difference between ENCHx and /ENCHx pins must be applied in order to enable x channel

ENABLE0 is the default setting. Mode selection is shown in the following figure:

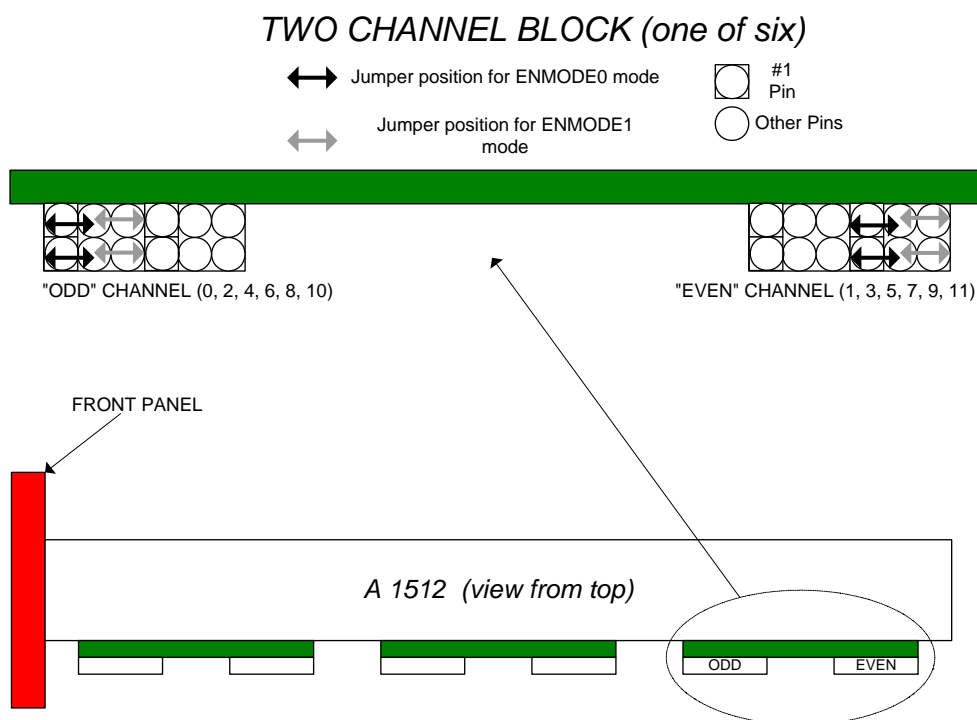


Fig. 4.5 – Enable mode jumpers setting

4.5 Sink mode

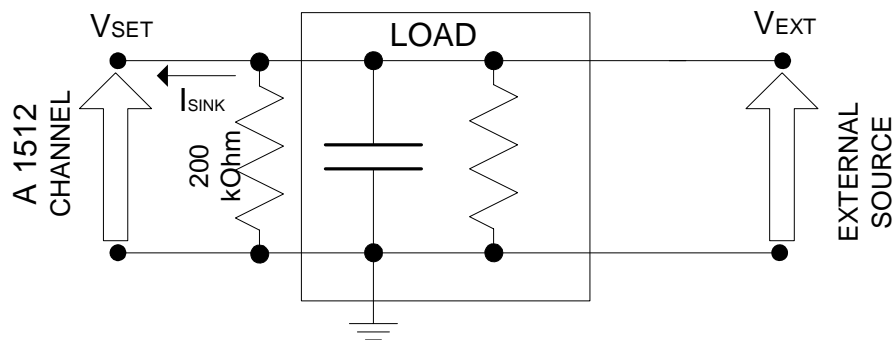


Fig. 4.6 – Current sinking

The Mod. A 1512 output channels can either draw or sink current; if the detector input load is supplied with an external voltage V_{EXT} larger than V_{SET} , the channel sinks current. If $|I_{MON}| > (I_{SET} + V_{SET} / 200 \text{ k}\Omega)$, with $3 \pm 0.5 \text{ mA}$ hardware limit, the SINK status is signalled, the channel output trespasses V_{SET} and tends to equal V_{EXT} . The output voltage (after the TRIP time has passed, see § 2.1) decreases until turning off with a slow rate which may not coincide with the RAMP-DOWN value.

4.6 Connector wiring

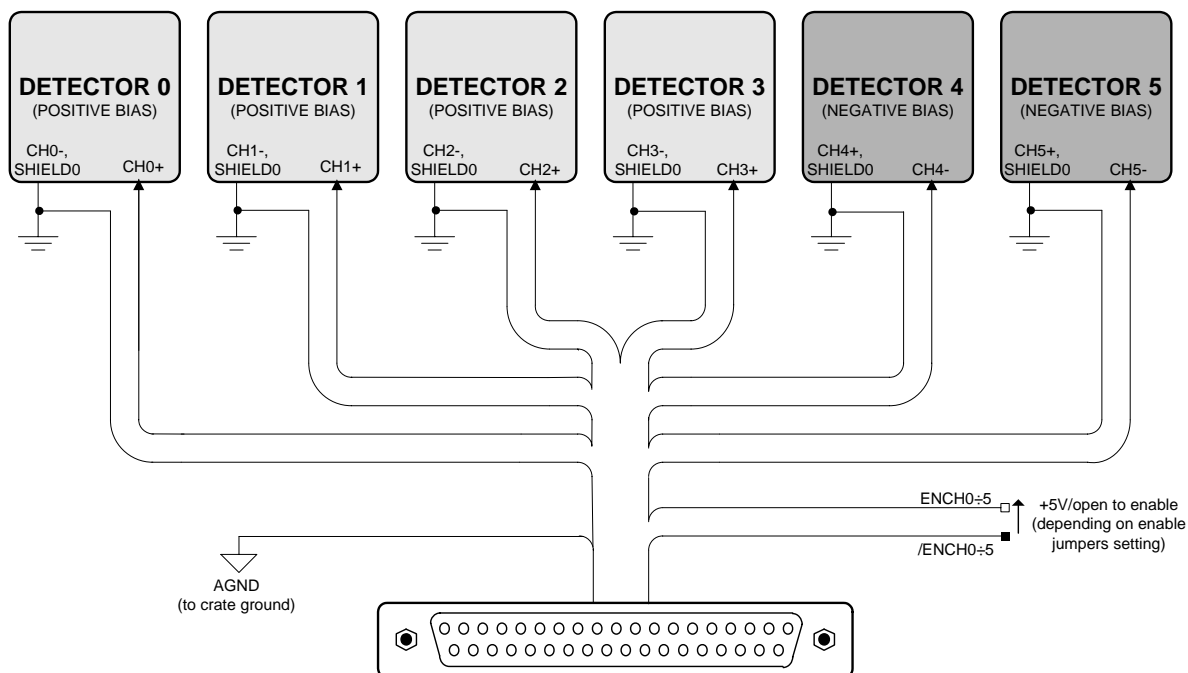


Fig. 4.7 – Example of connector wiring

The figure above shows an example of detector supplying using the Mod. A151x power supply boards. See also § 4.4 and § 4.6 for pinout and enable details.